TechPro Merlin

Pilot Operating Handbook

Aircraft type / version: **Merlin Mk 1**

Manufacturer: **TechPro Aviation**

Serial no: **0012**

Registration no: **G-CIWL**

Date of publication: **20 JANUARY, 2016**

This manual must stay with the aircraft and be made available to all pilots.

LIST OF REVISIONS AND CORRECTIONS

Revision #:	Bulletin #:	Pages in question:	Date:	Signature:

Introduction

This manual is part of each Merlin aircraft. It is intended to provide all the information necessary to operate the aircraft safely.

Legal certification base

This aircraft has been designed in compliance with ICAO regulations describing the operations and maintenance of sport flying equipment and the following regulations have been used for approval and certification:

UL-2 – Requirements for Airworthiness of sport flying equipment. Ultralight airplane steered aerodynamically. Regulation of Light Aircraft Association of Czech Republic.

In the UK the Merlin may be registered as a deregulated Microlight.

WARNINGS CAUTIONS AND ALERTS

This manual the following warning levels are used: WARNING, CAUTION and ALERT:

WARNING: Information about catastrophic situations that may result in death or airplane destruction.

CAUTION: information about situation that may result in injury or damage to airplane.

ALERT: information with significant importance for the pilot.

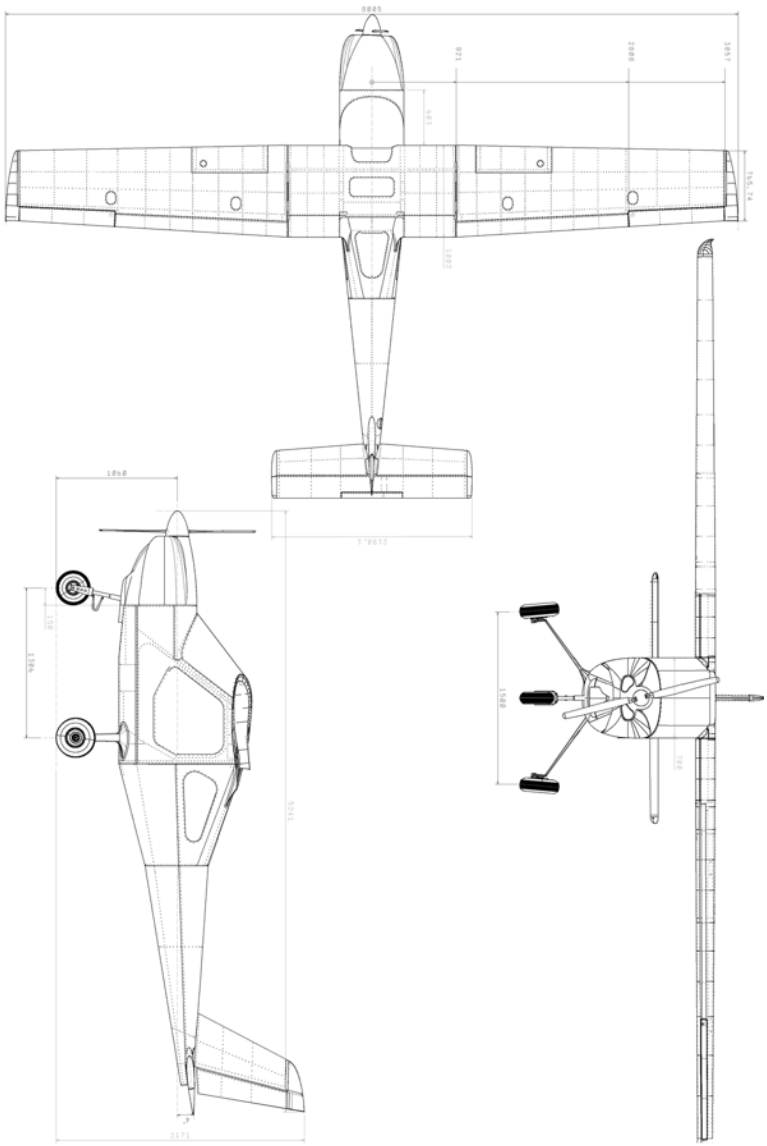
Pilot Operating Handbook - Merlin SSDR

BASIC DESCRIPTION

MERLIN is an all-metal (6061-T6) high wing airplane. Some nonstructural parts are fabricated from glass fibre composite.
The Merlin is equipped with 65 HP Rotax 582 engine with three blade 1700mm (68.1 inch) diameter propeller.

Wing span	**7.8** m
Length	**5.241** m
Height	**2.2** m
Wing area	**7.1** m^2
Mean aerodynamic chord	**0.917** m
Max. TO weight (no BRS)	**300 kg**
Max TO weight with BRS	**315.0 kg**

THREE BASIC VIEW



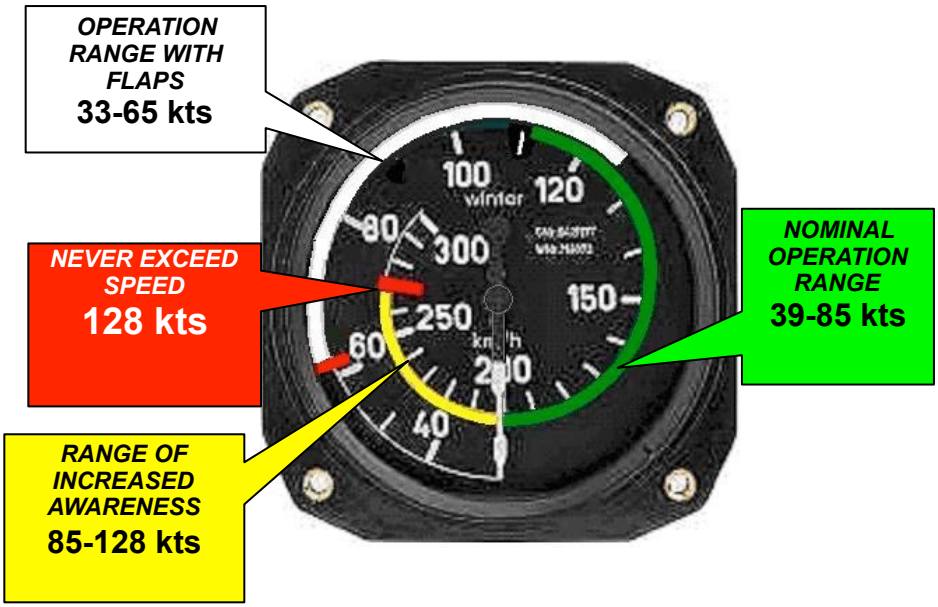
LIMITS

All given airspeeds in this manual are indicated IAS. For conversion see calibrating table 5.1

AIR SPEED LIMITS

WARNING: Do NOT use large control surface deflection when flying faster then V_A. You may cause overload.

airspeed		IAS km/h	IAS kts
V_{NE}	Never exceed speed	**240**	**128**
V_{NO}	Maximum structural cruise speed	**160**	**85**
V_A	Designed maneuvering speed	**150**	**79**
V_{RA}	Maximum speed in turbulence	**171**	**92**
V_{FE}	Maximum speed with flaps extended	**120**	**65**
V_{S1}	Stall speed without flaps	**75**	**39**
V_{S0}	Stall speed with flaps	**62**	**33**


OPERATION RANGE WITH FLAPS
33-65 kts
NEVER EXCEED SPEED
128 kts
RANGE OF INCREASED AWARENESS
85-128 kts
NOMINAL OPERATION RANGE
39-85 kts
100
120
80
300
150
250
60
40
km/h

AIRSPEED MARKING

WARNING: Pilot is obliged to choose the path in a way that it is possible to perform safe emergency landing in case of loss of power.

ENGINE ROTAX 582

The MERLIN is powered by a 65HP engine **Rotax 582**

Max. TO power (HP)	65
Max. continious power (kW)	40
Max. RPM (5 min)	**6400** rpm
Max. RPM continuous	**6 000** rpm
Max. cylinder temp (°C)	150
Max. coolant temp (°C)	80
Min-Max fuel press (bar)	0.2-.5
Operating ambient temperature range	-20°C
	+ 40°C

For more information, see engine users manual.

ENGINE INSTRUMENT INDICATION

The Rotax 582 must be equipped with a tachometer.

WARNING: Comply with these weight limits. Be aware of the amount of fuel.WARNING: Make sure not to exceed maximum allowed weight.

Max. RPM (red)	6400
Max. RPM continuous (yellow)	6000
Max. coolant temp (yellow)	80
Max. EGT (ºC) (red)	650

MASS LIMITS

Following values are for MERLIN with minimum flight equipment.

WARNING: Aerobatics and spins are forbidden.
Max bank angle: 60°

Each aircraft must must be weighed and a weight and balance placard displayed in the cockpit.

Empty weight (standard version) (kg)	185
Max TO weight (no BRS) (kg)	300
Max crew weight (kg)	Up to max TO weight
Min crew weight (kg)	55
Max luggage weight (kg)	10

MAX CREW WEIGHT (kg)
Allowing for fuel and luggage

MAX CREW WEIGHT (kg) According to fuel and luggage						
FUEL	**Fuel gauge**	100%	75%	50%	25%	12.5%
	Amount of fuel (kg/litr)	**14.4/ 20**	**10.8/ 15**	**7.2/ 10**	**3.6/ 5**	**1.8/ 2.5**
LUGGAGE	Max: **10 kg**	76.2	83.4	90.6	97.8	101.4
	½: **5 kg**	81.2	88.4	95.6	102.8	106.4
	None: **0 kg**	86.2	93.4	100.6	107.8	111.4

CENTER OF GRAVITY

Front limit CG	**25** % MAC
Rear limit CG	**35** % MAC

See chapter 6: Weight & Balance & CG determination.

ALLOWED MANEUVERS

Steep turn (max. bank 60°)

LOAD FACTOR LIMITS – "G"

Flaps **0°**	Max positive load in CG	**+ 4**
	Max negative load in CG	**- 2**
Flaps **extended**	Max positive load in CG	**+ 2**
	Max negative load in CG	**0**

CREW

MERLIN PSA is single seat airplane. The crew consists of one pilot.

OPERATION

FUEL

APPROVED FUELS

Auto premium unleaded gas
(Standard fuel for gasoline engines, ASTM D 4814 or AVGAS 100 LL)

ALERT: Using AVGAS increases engine lead build up. Use AVGAS only when no other fuel available.

For more informations see engine manual.

FUEL TANKS CAPACITY

One wing tank's capacity (usible)	**20**L
Total fuel capacity	**40**L
One wing unusible fuel	**0,8**L
Total unusible fuel	**1,6**L

OTHER LIMITS

Max. cross wind	8 knots (4 m/s)
Max. wind in the runway direction	16 kts (8 m/s)

Max outside temp	40 °C
Min outside temp	-20 °C

Heavy rain or high humidity may decrease performance. During the flight in high humidity it is recommended to increase the landing speed by 10km/h.

Side slipping is permissible with and without flaps providing normal piloting rules are applied.

LABELS

OPERATION VALUES AND LIMITS		
Registration nr.:		
Empty weight:	189	kg
Max take off weight:	300	kg
Max useful load:	111	kg
Max luggage weight:	10	kg
Min crew weight:	55	kg
Never exceed speed	128	kts
Max cruise speed	100	kts
Max speed in turbulence	85	kts
Max speed on flaps	65	kts
Stall speed on flaps (30°)	33	kts

This aircraft is a deregulated single seat microlight and is operated on Pilots own risk.

Aerobatics and spins are forbidden.

MAX CREW WEIGHT (kg) According to luggage and fuel						
Fuel	**Fuel gauge**	100 %	75 %	50 %	25 %	30 min flight
	Amount of Fuel (kg/litr)	20 / 25	15 / 18.7	10 / 12.5	5/ 6.2	2,5/ 3.1
Luggage	Max: **10 kg**	94	104	114	124	129
	½: 5 kg	99	109	119	129	134
	None: **0 kg**	104	114	124	134	139

22.5 **liters**
Premium 95
min. MON 85 RON 95

ENGINE RPM	
Max RPM (max 3min)	**6500**
Max continouous RPM	**6000**
Idle RPM	**2300**

Baggage
max.
10 kg

EMERGENCY PROCEDURES

This chapter recommends procedures on how to solve non-standard situations during operating flying sport equipment.
Emergency situations due to failure of airplane are highly improbable, if operated as described in the user manual and regular technical inspections are performed.

ENGINE FAILURE AND EMERGENCY LANDING

FAILURE DURING TAXIING

- throttle	idle
- ignition	off
- main switch	off
- brakes	as needed

FAILURE DURING TAKE OFF

- airspeed - **110** km/h
- choose place for landing
  - below 150 ft: in path, if possible
  - above 150 ft: any suitible, runway if possible
- ignition - off
- fuel valve - closed
- flaps - retracted, trim
- main switch - off
- safety belt - tighten
- brakes - after touch down as needed

MIDAIR FAILURE

- airspeed	reduce to **110** km/h
- trim	
- flaps	as needed
- choose landing site	

Make sure that ignition, main switch and fuel valves are in ON position. Continue with midair engine restart procedure as instructed in section 3.2 or continue with emergency landing – section 3.1.2.

CARBURETOR AND ICING

- airspeed	as needed, min 120km/h
- throttle	change throttle setting to stop the icing

- leave the icing area if possible
- after 90 seconds increase throttle up to cruise setting
- if the thrust does not increase and go for landing on nearest airfield, for more see 3.1.2

MIDAIR ENGINE RESTART

- airspeed	**130** km/h
- main switch	on
- fuel valve	open
- throttle	1/3
- ignition	in
- starter	start

If the battery is weak, increase speed up to 150-170 km/h to spin the propeller

FIRE

ENGINE FIRE ON GROUND

- fuel valve	closed
- throttle	full
- ignition	off
- main switch	off

- leave the cockpit and use the fire extinguisher if possible

MIDAIR ENGINE FIRE NEAR AIRFIELD

- throttle	idle
- fuel valve	close
- near airfield	maintain **115** km/h and go for landing
- brakes	as needed to full stop

After stop:

- ignition	off

- leave the cockpit and use the fire extinguisher if possible

MIDAIR ENGINE FIRE

- fuel valve	closed
- throttle	full
- airspeed	increase – try to “blow out“ the fire, **do not exceed V_{NE} !**
- place for landing	nearest airfield or other suitible landing site
- ignition	off
- airspeed	110km/h
- flaps	as needed, trim
- main switch	off
- safety belts	tighten

- perform emergency landing
- leave the cockpit and use the fire extinguisher if possible

ELECTRICAL FIRE IN COCKPIT

- open fully all ventilation, partly open the doors if possible

- turn off all instruments (lights, radio,…)
- land immediatly

GLIDING

Optimum speed for max glide ratio	**51** kts
Max glide ratio	**L/D = 13.6**

FORCED EMERGENCY LANDING

- choose suitible landing site, consider surface (bumps, obstacles)
- consider the wind (strength, heading)
- perform fly by at 120km/h, small flaps, 150 ft, re-consider chosen site
- use normal landing procedure

after touch down:

- ignition	off
- main switch	off
- fuel valve	closed
- brakes	as needed

LANDING WITH LOW PRESSURE IN TIRES

Use normal landing approach and procedure, keep the damaged wheel of the ground as long as possible.

LANDING WITH DAMAGED LANDING GEAR

Use normal landing approach and procedure; keep the damaged part of the landing gear of the ground as long as possible.

VIBRATION AND OTHER ENGINE PROBLEMS

Vibration:

- set throttle to position, where the vibrations are the smallest
- land as soon as possible, consider emergency landing should the vibration increase

Oil pressure (if applicable) loss:

The loss of oil pressure may indicate engine failure. Reduce throttle and go for landing as soon as possible. Consider emergency landing.

UNEXPECTED ENCOUNTER WITH ICING

- throttle	increase throttle above nominal cruise
- heading	turn around or change the heading in order to avoid icing area
- altitude	change the altitude

UNEXPECTED ENCOUNTER WITH TURBULENCE

- airspeed	reduce to maximum **140** km/h
- safety belts	tighten
- free objects in cockpit	secure

MALFUNCTION OF ELECTRIC SYSTEM

Should the electrical system fail, switch off all electrical non-essential instruments, thus the battery will power only the most important.

UNINTENTIONAL SPIN RECOVERY AND STALL

Stall or spin should not occur during nominal operation.

STALL RECOVERY:

- push down the nose below the horizon by pushing the control stick away from you
- slowly throttle up

Loss of altitude in direct horizontal flying to recover stall: 150 - 200 ft.

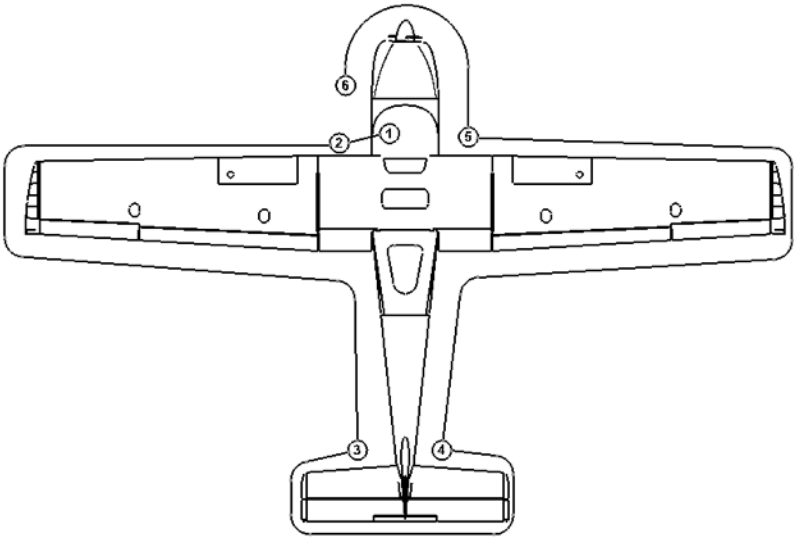
SPIN RECOVERY

- throttle	idle
- ailerons	neutral
- rudder	counter the rotation
- elevator	pull down

Once the rotation stops, put rudder in neutral position and level the flight.

NOMINAL PROCEDURES

PREFLIGHT CHECHK



COCKPIT

- Main switch and ignition - off
- Safety belts - check
- Instruments and equipement - check
- Control stick - freedom of movement
- Rudder pedals - freedom of movement

(keep in mind: rudder control is connected to front wheel steering)

- Cable steering circuit - freedom of movement, tension
- Throttle - freedom of movement
- Brakes - functionallity
- Check the condition of plexiglass lock mechanismus.

LANDING GEAR

- Landing gear and brakes - check
- Leg and mounting - check
- Laminate spring (front wheel) - check
- Tire pressure - check
- Tire - check

ENGINE

- Engine and propeller, condition	- check
- Pins, safety wires	- check
- Engine mount	- check
- exhaust pipes	- check
- Ignition system	- check
- Fuel system	- check, drain sumps
- Cooling system	- check
- Amount of oil and water	- betwee MIN - MAX lines

WINGS

- Surface and tips	- check, look for damage
- Flaps – surface, hinges	- check
- Ailerons – surface, hinges	- check freedom of movement, deflections
- Fuel tank leaks	- check
- Remove pitot-tube cover	

FUSELAGE AND EMPENNAGE

- Surface of empennage	- check, look for damage
- Rudder and elevator	- check freedom of movement, deflections
- Trim	- check
- Surface of fuselage	- check, look for damage

ENGINE START PROCEDURE

- pre-flight check	done
- safety belts	set and secure
- instruments	check readings, set correct readings
- cockpit door	closed and secured
- main switch	on
- fuel valve	open (right or full tank)
- throttle	idle
- control stick	pull down position
- brakes	full brakes
- propeller area	clear
- ignition	on
- starter	on *(max 10 sec. without interruption, then 2 minutes cooling period)*
- after engine start	set RPM to idle mode
- instruments	check indication

flight instruments and others as needed

While starting cold engine, it is recommended to spin the propeller 4-6x by hand. Make sure to spin in the correct direction. Throttle is set to idle, fuel valves open, ignition off.

ENGINE WARM UP AND TEST

- warm the engine up to nominal temp. (see page 2-7)
  - Set **2400 RPM** and keep 2-3 minutes
- check temp and pressure
  - cooling water must not exceed **80°C**
- check ignition
  - Set **3 850**RPM, one by one tor of and on ignition I/II. After one circuit is of, RPM must not decrease for more then **300.** The difference between I/II may not exceed **120**.
- check maximum power
  - set RPM to 7100 ± 100
- check idle: **2200-2300**RPM

CAUTION: The engine test may be performed on airplane, that is secured against movement, the surrounding area must be clear, airplane must be situated against the wind.
Mind the safety of others. Do not run the engine longer than necessary.
Make sure the engine can cool after turning off.

TAXIING

maximum velocity for taxiing is 15 km/h. Always check the brakes before taxiing.

NOMINAL TAKE OFF

- brakes	as needed
- trim	neutral
- flaps	Take off position
- main switch	on
- ignition	on
- fuel gauges	check amount of fuel
- instruments	check
- cockpit door	closed and secured
- safety belts	secure, tighten
- steering	freedom of movement
- runway and airfield	

check any obstacles and other potential hazards
- radio report

increase throttle to max power. Rotation at 30-40km/h. Pull up slightly at **70-80** km/h and accelerate up to 90-100km/h. Then climb.

- airspeed for climbing 100-110 km/h
- RPM reduce to max 6500 ot/min
- engine instruments check
- flaps retract above 150 ft
- trim

CLIMB

- airspeed 105km/h

HORIZONTAL FLIGHT

- level the airplane
- RPM **5,000 – 6,500**
- airspeed as needed
- engine instruments check
- fuel valve switch as needed

Optimum condition for level flight is **130-160km/h** at **5,000-6,100 RPM**

APPROACH AND LANDING

DESCENT

- throttle as needed
- engine instruments check readings

DOWNWIND

- throttle set to horizontal flight
- airspeed **120-130** km/h
- engine instruments check readings

- safety belts	tighten
- situation	cleared for landing
- brakes	check

NORMAL LANDING

BASE/3RD TURN

WARNING: Different pilot skills as well as airplane settings (such as propeller angle) may cause significant differences.

- throttle	throttle down for descend
- airspeed	**100** km/h
- engine instruments	check readings
- flaps	take off position I
- trim	as needed
- situation	cleared for landing

FINAL

- airspeed	**90-100** km/hod
- throttle	as needed
- engine instruments	check readings
- flaps	landing position 30°
- trim	as needed
- situation	cleared for landing

LANDING

At 30ft throttle down to idle. Maintain 90-100km/h until the final pull up. Alwas touch down on main landing gear. After touch down keep front wheel airborne as long as possible.

AFTER LANDING

- brakes	as needed
- flasp	retract
- instruments	shut down not required

Engine stop

- throttle	cool the engine (throttle to idle)
- instruments switches	off
- ignition	off
- main switch	off
- fuel valve	close
- secure the airplane	brakes, parking position, lock the control

POST FLIGHT INSPECTION

Inspect the airplane.

ABORTED LANDING

- throttle	slowly throttle up to max power
- airspeed	minimum **100** km/h befor climb
- trim	
- flaps	Take off position
- engine instruments	check readings
- flaps	retract at 150 ft
- trim	
- airspeed	**100-110** km/hod

USAGE OF FUEL SYSTEM

There are two integrated fuel tanks in the wings. The fuel flows through hoses to the instrument panel fuel valve in cockpit and the engine.

PERFORMANCE

These parameters belong to the MERLIN SSDR with the Rotax 582 engine. Maximum take off weight is 300 kg. The pilotage is nominal and conditions correspond to those of international standard atmosphere (ISA).
The real performance may vary to those shown below. Performance depends on pilot skill, weather, airplane condition.

AIRSPEED INDICATOR CALIBRATION

IAS km/h	**80**	**100**	**120**	**140**	**160**	**180**

IAS – Indicated Air Speed, reading on your instrument

STALL SPEED

Values below belong to the airplane with maximum take off weight 300kg and horizontal flight.

	Stall speed (kts IAS)
Flaps retracted	**39**
Flaps 30°	**33**

TAKE OFF RUN

The length of take off on grass with the Rotax 582 engine is 160m. Total distance of take off and climb to 50ft is 290m. The flaps are set to 20°.

LANDING DISTANCE

The length of landing (descend from 50ft) is 640m. The Landing run is 180m. The conditions are for the Rotax 582 engine, grass runway surface, flaps set to 30°.

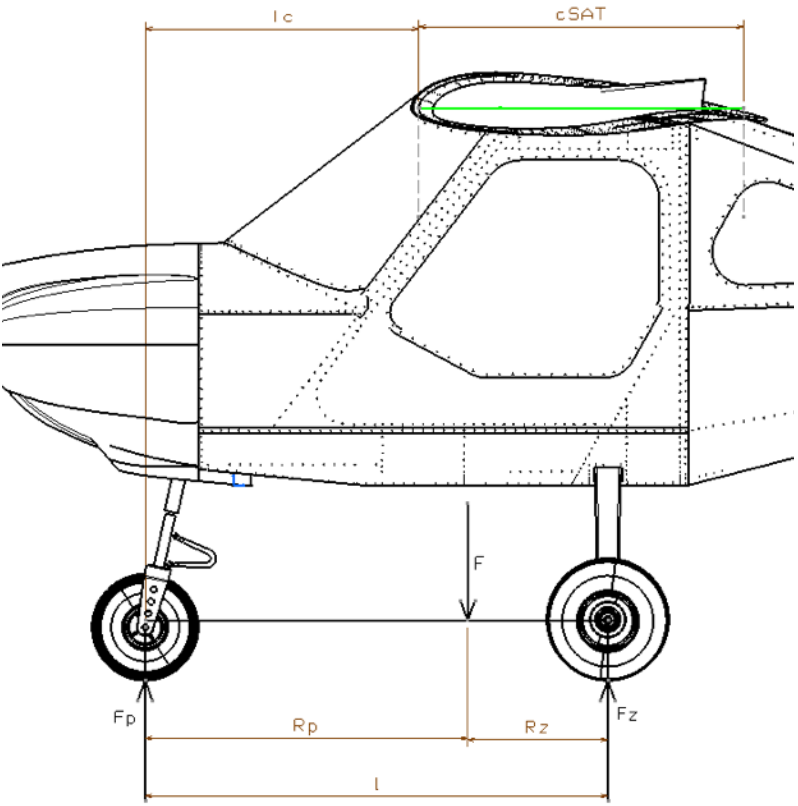
CLIMB RATE

Altitude	Rotax 582	Airspeed for maximum climb rate (IAS)
0 ft Calculation	**5** m/s	105 km/h
	16,5 ft/s	61 kts
3000 ft measurement	**2,5** m/s	90 km/h
	8,0 ft/s	49 kts

CAUTION: If nonstandard equipment is installed, it is necessary to calculate actual CG position. It is recommended to support the calculation by measurement as shown above.

WEIGHT AND CENTER OF GRAVITY

DETERMINATION OF WEIGHT AND CG



When weighing the airplane, the scales are under the wheels. All wheels must have correct dimension (see figure above).
Before taking any measurement check the tire pressure. Also check the airplane stands in a level position.
The reference plane, is the wing leading edge at the center section. All liquids must be at maximum (oil, brakes, cooling system). The tanks are empty, only the unused volume (2x0.8L) remains.
The following dimensions must be measured:

Weight on front wheel	F_P =	kg
Weight of left main wheel	F_Z =	kg

Wheelbase L = mm

Correct wheelbase is L=1306mm

Distance between leading edge in root of the wing and front wheel LC = mm

Correct distance is L=773mm

Mean aerodynamical chord: c_{MAC} = 917 mm

Empty weight of the airplane: $F = F_P + F_Z [kg]$

Distance of CG from front wheel: $R_P = \frac{F_Z}{F} \times L = [mm]$

Center of Gravity: $\overline{X_T} = \frac{R_P - LC}{c_{SAT}} \times 100 [\%]$

Acceptible position of the empty CG is (empty airplane as described above): 25±2% c_{MAC}, that is 18 - 25 % c_{MAC},

This measurement must be done after each construction change.

Date:	Empty weight [kg]	CG	
		R_P, [mm]	X_T [%]

Center of Gravity

The correct position of CG is secured when the weight limits of fuel, pilot and luggage weights are as shown in chapter 2.

Allowed position of CG for safe flying is 25-35% c_{MAC}

MANIPULATION AND SERVICE

CAUTION: Always hold the wing at a place where there are rivets. Other ways may cause damage.

PARKING AND ANCHORAGE

GENERAL

Always, when parking, secure the airplane against movement. It is recommended to anchor the airplane in strong wind or if grounded for extended period of time (overnight,...).
Recommended ground equipment:

- pitot-static protection
- anchoring set
- canvas cover for windows and wings

Pushing or leaning over the control surfaces is prohibited.

PITOT-STATIC PROTECTION

Pitot-static tube needs to be protected against foreign objects (dust, insect,…) by a cover. The cover must be visible and contain clear marking 'REMOVE BEFORE FLIGHT'.

ANCHORING

The minimum recommended set for anchoring the airplane contains:

- 3 anchoring bolts,
- 2 long and 1 short anchoring rope.

For anchoring the airplane are recommended stiff and strong parts such as the wing tie down points and/or landing gear (both front and main leg).

HANGAR

It is recommended to push the empty airplane during manipulation in hangar. Grasp the apex of the empennage at the vertical stabilizer rib position and push down. This will ease up the front wheel.

This way you can easily steed the airplane.
Another person may help by pushing the leading edge of the wing while moving backwards.

TOWING

Towing by car is prohibited.

TIRE PRESSURE

Front wheel - **180+20** kPa / 26,5 + 3 psi
Main wheels - **180+20** kPa / 26,5 + 3 psi

DISASSEMBLE OF THE AIRPLANE

WINGS

Before removing the wings, you have to empty the fuel tanks in the wings. For this purpose use the valves under the lower surface of the tanks.
Then prepare some holders for the wings. Make sure the holders will not damage the wings (scratches, penetrations,…).
There must be three persons to take of the wings.

Preparing the wings for dismounting:
Remove the cover (aluminIum strip between the centre wing and the outer wing). Disconnect the hoses of pitot-static and fuel systems. Make sure to wipe the leaking fuel from the hoses. The fuel must not get into the construction. Also disconnect all the electrical installations. Fix the flap to the wing (for example by a stretch foil). Disconnect the spherical joint actuating the flap.
In the cockpit, just above pilots head is located the aileron control system. Disconnect two push/pull tubes from the lever. Then remove the sleeves mounted on the tubes.
Remove the nuts and washers connecting the outer wing with the central part. There are three bolts for each wing. The main spar is connected with two large bolts, the rear spar with single bolt.

Wings dismounting:
One person stands at the tip of the wing and slightly pushes upwards to lighten the wing. Other person removes the bolt from the rear spar. Then he starts to strike the bolt in the main spar. Use small hammer made of soft metal (or you can use a cylinder made of soft metal).

Hit the top bolt first, then the bottom. Keep this pattern until the top of the screw meets the plane of the spar.
At this point the third person should hold the outer wing the root rib. The person at the tip of the wing is prepared to hold the weight of the wing.
While the first person strikes the bolds as before, the second person, at the tip of the wing makes small moves (2-3cm) up and down, forwards and backwards. These moves will help to get the bolts out easier.
When the two bolts are out, all the weight (about 15kg) is resting on the two persons (at the tip, at the root).
Put the free wing on previously prepared resting place. Keep in mind the aileron control tube sticking out of the wing.
For extended period of storage or transportation seal the hoses, lubricate the hinges and fix the flap and aileron deflection.

HORIZONTAL TAIL UNIT

Make sure there is no foreign object on the HTU (such as tools, cellphones,..)
Dismount two covers:
- on the top surface just below the rudder,
- on the lower surface at the trim drive.

Disconnect the electrical wires to the trim. Just behind the last fuselage rib disconnect the spherical joint of the elevator's control tube. Remove four bolts (two in the upper and two in the lower mounting hole).
It is convenient to have one person to have one person to support the HTU and thus prevent the damage the mounting bolts.